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THE SUBSPECIES OF THE SPADE-NOSED SNAKE,
SONORA OCCIPITALIS

By
WILLIAM H. STICKEL



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Although *Sonora occipitalis* (Hallowell), the spade-nosed snake, is restricted in distribution to the great Sonoran Desert, it can be divided into geographic subspecies, as can most species of limited vagility. Of the four races that may be recognized at present, one is new, one revived, and one treated as a subspecies of *occipitalis* for the first time.

The species as a whole is morphologically set apart from the other members of the genus by its flattened snout, angled abdomen, and nasal valve, all of which are adaptations to sand burrowing. The nasal valve, a previously undescribed adaptation, is a simple flap extending forward from the posterior wall of the anteriorly directed narial passage. To judge from preserved specimens the valve normally closes the tube, perhaps opening only for inhalation. The value of this device to an animal moving through loose sand is obvious. The question of whether or not these and various internal differences justify generic separation is being considered as part of the problem of generic affinities.

Sonora occipitalis occipitalis (Hallowell)

BICOLOR SPADE-NOSED SNAKE

Rhinostoma occipitale Hallowell, Proc. Acad. Nat. Sci. Phila., vol. 7, 1854, p. 95.

Type locality. — The most adequate information was provided by Hallowell subsequent to the original description (*loc. cit.*, vol. 8, 1856, p. 310): "Habitat. Mohave Desert, Southern California. One specimen in Smithsonian Institution, collected by Dr. A. L. Heermann." Dr. Doris M. Cochran informs me that the type is now lost. However, there is no doubt as to which subspecies the description fits.

*Contribution from the Department of Zoology, University of Michigan. Extracted from material prepared in partial fulfillment of the requirements for the doctoral degree.

Diagnosis. — The form typically has numerous (31 to 51) bands on body and tail. Few or none of the body bands encircle the trunk, and when they do they seldom broaden out on the abdomen. The bands are usually brown rather than black and the interspaces are without vermilion or red saddles although orange or yellow may be present in the ground color to some extent. Combination of the two band counts, total plus incompletely encircling, as used in the key, gives a character that identifies all but 5 out of 99 available specimens of the subspecies. The qualitative color characters, though often quite apparent, are too variable for use alone.

Distribution. — CALIFORNIA: *Riverside and San Bernardino Counties*—many localities. *Los Angeles Co.*—20 mi. E. of Lancaster; 3 mi. N. of Palmdale; near county line E. of Llano. *Kern Co.*—Brown; Garlock; 11 mi. E. of Mohave. *Inyo Co.*—Panamint Mts.; Owens Lake. NEVADA: *Clark Co.*—Boulder City. ARIZONA: *Mohave Co.*—Fort Mohave. *Maricopa Co.*—2.5 mi. E. of Aguila.

Remarks. — The race is known to be geographically and genetically close to *annulata*, under which the relationship is discussed.

A photograph of this subspecies appears in Van Denburgh's *Reptiles of Western North America* (Occ. Papers Calif. Acad. Sci., no. 10, 1922, vol. 2, pl. 95, fig. 1).

Sonora occipitalis annulata (Baird)

TRICOLOR SPADE-NOSED SNAKE

Lamprosoma annulatum Baird, U. S. and Mex. Bound. Surv., 1859, vol. 2, Reptiles, p. 22.

Type specimen. -- U. S. National Museum 2105, Colorado Desert.

Diagnosis. — Bands on body and tail are fewer (22 to 46) than in typical *occipitalis*, but many of them meet across the abdomen, ringing the body and often widening out on the ventrals. The black bands are separated by interspaces having saddles of vermilion on a cream or ivory ground. The total number of bands added to the number of incomplete body bands gives a diagnostic figure varying from 26 to 57 (excluding data for the San Diego County population discussed below). The range of variation, limited (as in the key) to 26-51, includes 73 of the 78 non-San Diego specimens examined.

Distribution. — CALIFORNIA: *Imperial Co.* and eastern *San Diego Co.*—many localities. ARIZONA: *Yuma Co.*—Yuma and vicinity; near Dublin; Wellton Mesa; Tacna and vicinity; Pembroke; Mohawk; Lugar Bonita (12 mi. E. of Wellton). *Maricopa Co.*—Gila Bend and vicinity; Cactus Garden (7 mi. S. of Wickenburg).

Remarks. — There is little doubt that *annulata* shades off into *klauberi* to the east and into *palarostris* to the south, but its relationship to *occipitalis* is rather complicated. The population of San Diego County, California, is represented by 143 specimens of which 23.7 per cent key out to *occipitalis*, although the group as whole is referable to *annulata*. The range of variation in this county exceeds that of either subspecies and many specimens show odd combinations of the subspecific characters. For these reasons I believe this population to be of hybrid origin. Dr. Klauber concurs in this opinion and has suggested a reasonable explanation. At the site of the present Salton Sea there was until very recent geological times a much larger body of water, Lake Cahuilla, which completely covered the valley floor. As this receded the northern and southern populations were able to migrate through the gap, mingle and interbreed. Possibly ecological factors operate to discourage the migration of *annulata* northward, for the *occipitalis* population of the Coachella Valley shows less indication of having interbred. The question is not simplified by the fact that two spade-nosed snakes from northern Maricopa County, Arizona, can be referred tentatively to different forms although taken but a few miles apart: *occipitalis* from near Aguila, *annulata* from 7 miles south of Wickenburg.* There is scant evidence of true primary intergradation between *occipitalis* and *annulata*, though it may be shown when more specimens from eastern Riverside and northwestern Yuma Counties are collected.

Good illustrations of *annulata* are given by Baird, U. S. and Mexican Boundary Survey, 1859, vol. 2, Reptiles, pl. 21, fig. 1, and Van Denburgh, *loc. cit.*, pl. 95, fig. 2.

Sonora occipitalis palarostris Klauber

SONORAN SPADE-NOSED SNAKE

Sonora palarostris Klauber, Trans. San Diego Soc. Nat. Hist., vol. 8, 1937, p. 363-365.

Holotype. — L. M. Klauber 26771, collected 5 miles south of Magdalena, Sonora, Mexico, by George Lindsay, April, 1937.

Diagnosis. — Very similar to *annulata*, this form has fewer bands on body and tail, but a higher percentage of the bands encircles the body completely, and the ventrals average fewer.

Distribution. — This subspecies is represented only by the holotype and by Museum of Comparative Zoology 36890 (Costa Rica ranch, 50 miles west of Hermosillo, Sonora; collected by Bailey and Winthrop, October 9, 1932).

*Chicago Acad. Sci. 3714 and L. M. Klauber 26919, respectively.

Remarks. — The MCZ specimen essentially agrees with the holotype but is less extreme. Thus, though it confirms the validity of the form, it also helps link it more closely to *annulata*. *Palarostris* is one end of a chain of three forms; it differs from *annulata* in the same manner in which the latter differs from *occipitalis*. Furthermore, the differences between *palarostris* and *annulata* are not great enough to justify specific status. The total number of bands of *palarostris* are 13 and 19, total bands plus number of bands not completely encircling 15 and 25, ventrals 143 and 144 (both males). *Annulata* has respectively for the same sex: 22-40, 26-57, 141-164 (av. 153.6). It is probable that the two forms intergrade in northwestern Sonora.

Until lately no spade-nosed snakes were known from east of Longitude 112°, but in recent years a few specimens have been turned up by intensive collecting in Arizona near Tucson, Picacho and Florence. The first two examples were deposited in collections under the care of Dr. L. M. Klauber, who recognized that they not only constituted extensions of the range but were representatives of an unnamed form. Dr. Klauber brought the specimens to my attention and insisted that I be the one to name them. In acknowledgment of his discovery of the form, as well as in recognition of his outstanding research and his constant helpfulness to other workers in the field of herpetology, it is appropriate that this snake should be named:

Sonora occipitalis klauberi, new subspecies

DOUBLE-BANDED SPADE-NOSED SNAKE

Holotype. — L. M. Klauber 29647, Tucson, Pima County, Arizona, collected by C. T. Vorhies, June 3, 1938 (Fig. 1).

Paratypes. — San Diego Society of Natural History 17115, 3 miles southeast of Picacho, Pinal County, Arizona, collected by L. M. Huey, May 16, 1937. Chicago Academy of Sciences 9921 (Fig. 2), 3 miles north of Florence, Pinal County, Arizona, collected by H. K. Gloyd, June 1, 1940; and CA 10261, 5.5 miles south of Florence Junction, Pinal County, Arizona, collected by H. K. Gloyd, June 22, 1941.

Diagnosis. — Morphologically like the other forms of *S. occipitalis*, this subspecies is characterized by having a double series of dark bands: secondary brown bands occur in the spaces between the primary black bands. The heavy and distinct intercalated bands are not to be confused with the dark edging and mottling sometimes seen in the light areas of other subspecies.

STICKEL: SUBSPECIES OF THE SPADE-NOSED SNAKE

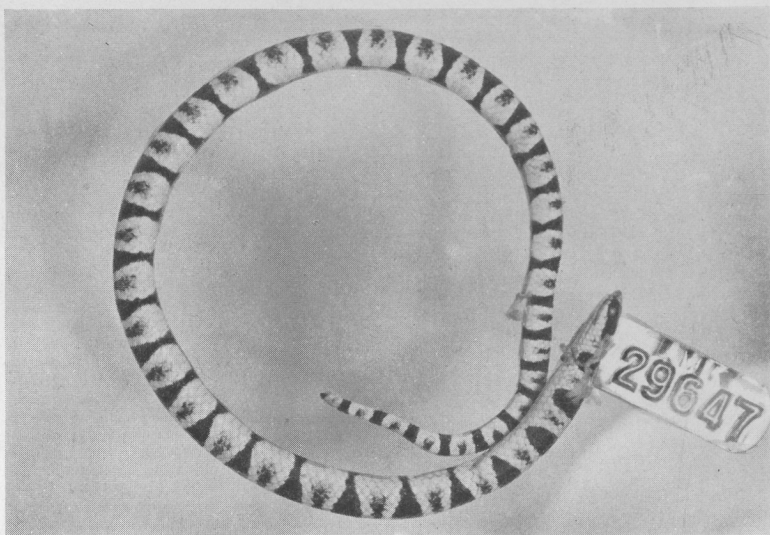


Fig. 1. *Sonora occipitalis klauberi*, new subspecies.
Holotype, L. M. Klauber collection; Tucson, Arizona.



Fig. 2. *Sonora occipitalis klauberi*, new subspecies.
Paratype, Chicago Acad. Sci. 9921; 3 miles north of Florence, Arizona.

Description of type. — Male; total length 282 mm., tail 52 mm. (tip lost?); ventrals 146; 43 caudals remaining; scale rows 15-15; supralabials 7; infralabials 7, preoculars 1; postoculars 2; loreals present; nasals entire; temporals 1-2; posterior genials separated by 2 small scales.

The primary black bands number 29 on the body and 10 on the tail. The body bands are widest middorsally and midventrally. The five anterior neck bands do not completely encircle the body, and the anterior three do not reach the ventrals. The ground color is cream. The brown secondary bands, present in all interspaces, are weakest on tail and nape. They are narrowest middorsally, becoming wider and more diffuse laterally, ending on the second row of scales on each side. The secondary bands are one scale wide—or broken—middorsally, and two scales wide laterally. Pink may appear where brown bands are broken dorsally, as on the tail. The horns of the black parietal crescent extend onto the loreal region.

Notes on the paratypes. — On SDSNH 17115, male, CA 10261, male, and CA 9921, female, the data are respectively: total length 281, 315, 318 mm.; tail length 54 (tip?), 61, 54 (tip?); ventrals 150, 151, 158; caudals 42 (?), 45, 40 (?); other scutellation as on holotype (CA 10261 is remarkable in having the upper and lower postoculars equal instead of the upper being much larger than the lower, as is usual in the species); primary bands on body 23, 26, 27; on tail 7, 8, 7; primary bands not completely encircling body 6, 3, 11; primary neck bands not extended onto ventrals 5, 2, 8; scale width of typical intermediate band 1-3, 1-2.5, 1-2, narrowest middorsally in each. In all the ground color is cream, black bands are as described for the holotype, and pink occurs where the secondary bands are broken dorsally. In SDSNH 17115 the horns of the head crescent stop on the preoculars.

Relationship. — Except for the presence of the series of intermediate bands, *klauberi* is very similar to *annulata*, particularly in the number, color, and ventral expansion of the black bands. It seems clear that *klauberi* was derived from *annulata* by the obliteration of the latter's red areas by brown. As far as known, *klauberi* is geographically isolated from *occipitalis* and *palarostris*, but an intergrade with *annulata* has been seen from 12 miles east of Gila Bend, Maricopa County, Arizona (LMK 29510). It may be that intergradation is gradual across south-central Arizona, as a few specimens of *annulata* from the western part of the state show tendencies toward *klauberi*.

Distribution. — As this subspecies is recorded only from Tucson, Picacho, and Florence, Arizona, in Pima and Pinal Counties, the distribution, particularly to the south, is an open question. To the east it probably does not extend beyond the mountains of eastern Pima and Pinal Counties, while at the north the Colorado Plateau is presumably an effective barrier. Westward the form is replaced by the intergrading race, *annulata*.

Remarks. — Dr. Gloyd, who collected the first female specimen of the subspecies writes, "It lifted its head about two inches above the ground with the neck almost perpendicular and the head horizontal, and crawled along for all the world like a minute cobra."

The following key outlines the characteristics that most satisfactorily define the four forms. It will properly identify about 88 per cent of the known specimens.

Key to the Subspecies of *Sonora occipitalis*

- 1 No definite, secondary, brown crossbands present between the primary dark bands, although there may be dark edging and speckling on the scales of the interspaces in occasional specimens.
 - 2 Total number of bands (on body and tail) plus the number of body bands not entirely encircling the body equals 52 or more; bands usually brown; interspaces without reddish saddles. *S. o. occipitalis* (Hallowell).
 - 2' Total number of bands plus number of incomplete body bands equals 51 or less; bands usually black, widened on the abdomen; interspaces with ill-defined reddish saddles on light ground color (at least in life).
 - 3 Total number of bands 22 or more. *S. o. annulata* (Baird).
 - 3' Total number of bands 21 or fewer. *S. o. palarostris* Klauber.
- 1' With definite, secondary, brown crossbands present between the primary darker bands; the pigmentation of the secondary bands arising at the bases of the scales rather than at their edges. *S. o. klauberi*, new subspecies.

Acknowledgments. — To the many institutions and individuals who have generously loaned specimens and provided information for the study of this genus I express my sincere gratitude. For having criticized the manuscript of this paper I wish to extend my thanks to Dr. Carl L. Hubbs, Dr. Howard K. Gloyd, Dr. Laurence M. Klauber and Dr. Hobart M. Smith.